

We Claim:

1. An extruded wood-plastic profile, said profile comprising:
  - (a) a wood component;
  - (b) a plastic component,
  - (c) said wood component and said plastic component being intermixed to form a profile body; and
  - (d) a bonding agent for improving the adherence between said wood component and said plastic component.
2. The wood-plastic profile according to Claim 1, wherein said profile surface is substantially free of voids.
3. The wood-plastic profile according to Claim 1, wherein said plastic component is substantially a thermoplastic and further including a dimensionally stable shell surrounding said profile body, wherein said dimensionally stable shell has a shell temperature less than said melting point of said then-noplastic plastic component.
4. The wood-plastic profile according to Claim 3, wherein said melting point of said thermoplastic plastic component is less than about 150°C.
5. The wood-plastic profile according to Claim 1, wherein said wood component has a bulk density of between about 18 lbs/ft<sup>3</sup> and 22 lbs/ft<sup>3</sup>.
6. A wood-plastic profile according to Claim 5, wherein said wood component has a bulk density of about 20 pounds/ft<sup>3</sup>.
7. The wood-plastic profile according to Claim 1, wherein said profile is comprised of between about 40 wt.% and 65 wt.% wood.

8. The wood-plastic profile according to Claim 7, wherein said profile is comprised of about 52 wt.% wood.

9. The wood-plastic profile according to Claim 1, wherein said wood component is comprised of a plurality of wood particles, wherein each of said wood particles has a particle size of less than about 30 mesh.

10. The wood-plastic profile according to Claim 1, wherein said wood component is selected from the group consisting of hardwoods and soft woods.

11. The wood-plastic profile according to Claim 10, wherein said wood component is a hardwood.

12. The wood-plastic profile according to Claim 1, wherein said plastic component is substantially comprised of thermoplastic materials having a melting point range.

13. A wood-plastic profile according to Claim 12, wherein said plastic component comprises between about 97 wt.% and 98 wt.% thermoplastic material.

14. The wood-plastic profile according to Claim 12, wherein said thermoplastic material is substantially polyethylene.

15. The wood-plastic profile according to Claim 1, wherein said plastic component has a melt index of less than about 2.

16. The wood-plastic profile according to Claim 1, wherein said plastic component is comprised of flake-shaped plastic particles.

17. The wood-plastic profile according to Claim 16, wherein each of said flake-shaped plastic particles has a size of less than about 3/4 inches.

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18. The wood-plastic profile according to Claim 16, wherein said flake-shaped plastic particles have a bulk density of less than about 3 lbs/ft<sup>3</sup>

19. The wood-plastic profile according to Claim 1, wherein said plastic component is comprised of pellet-shaped plastic particles.

20. The wood-plastic profile according to Claim 19, wherein said pellet-shaped plastic particles have a bulk density of between about 28 lbs/ft<sup>3</sup> and 35 lbs/ft<sup>3</sup>.

21. The wood-plastic profile according to Claim 1, wherein said profile has a thickness of about 1 1/2 inches and a width of between about 3 1/2 and 9 inches.

22. The wood-plastic profile according to Claim 1, wherein said profile has a thickness of about 1 inch and a width of between about 4 to 5 1/2 inches.

23. The wood-plastic profile according to Claim 1, wherein said profile has a thickness of about of 3 1/2 inches and a width of about 3 1/2 inches.

24. The wood-plastic profile according to Claim 1, wherein said profile has a thickness of about 1 3/4 inches and a width of about 1 3/4 inches.

25. A wood-plastic body, said body comprising:

- (a) a wood component;
- (b) a plastic component said wood component and said plastic component being intermixed to form a body; and
- (c) a bonding agent for improving the adherence between said wood component and said plastic component, said bonding agent including a thermoplastic component and at least one bonding site.

26. The wood-plastic body according to Claim 25, wherein said thermoplastic component is a polyethylene.

27. The wood-plastic body according to Claim 25, wherein said bonding agent has a melt index value greater than the melt index value of the plastic component.

28. The wood-plastic body according to Claim 27, wherein said bonding agent melt index value is about 5.

29. The wood-plastic body according to Claim 25, wherein said at least one bonding site is an anhydride.

30. The wood-plastic body according to Claim 29, wherein said anhydride is a carboxylic acid anhydride.

31. The wood-plastic body according to Claim 30, wherein said carboxylic acid anhydride is a maleic anhydride.

32. The wood-plastic body of Claim 31 wherein the maleic anhydride content of the bonding agent is greater than about 1 weight percent.

33. The wood-plastic body according to Claim 25, wherein said bonding agent is about 2 wt.%.

34. An extruded wood-plastic profile, said profile comprising:
- (a) a wood component;
  - (b) a plastic component, said wood component and said plastic component being intermixed to form a profile body;
  - (c) a bonding agent for improving the adherence between said wood component and said plastic component, said bonding agent including a thermoplastic component and at least one bonding site; and
  - (d) wherein said profile surface is substantially free of voids .

35. The wood-plastic profile according to Claim 34, wherein said plastic component is substantially a thermoplastic and further including a dimensionally stable shell surrounding said profile body, wherein said dimensionally stable shell has a shell temperature less than said melting point of said thermoplastic plastic component.

36. The wood-plastic profile according to Claim 35, wherein said melting point of said thermoplastic plastic component is less than about 150°C.

37. The wood-plastic profile according to Claim 35, wherein said wood component has a bulk density of between about 18 lbs/ft<sup>3</sup> and 22 lbs/ft<sup>3</sup>.

38. A wood-plastic profile according to Claim 37, wherein said wood component has a bulk density of about 20 pounds/ft<sup>3</sup>.

39. The wood-plastic profile according to Claim 35, wherein said profile is comprised of between about 40 wt.% and 65 wt.% wood.

40. The wood-plastic profile according to Claim 39, wherein said profile is comprised of about 52 wt.% wood.

41. The wood-plastic profile according to Claim 35, wherein said wood component is comprised of a plurality of wood particles, wherein each of said wood particles has a particle size of less than about 30 mesh.

42. The wood-plastic profile according to Claim 35, wherein said wood component is selected from the group consisting of hardwoods and soft woods.

43. The wood-plastic profile according to Claim 42, wherein said wood component is a hardwood.

44. The wood-plastic profile according to Claim 35, wherein said plastic component is substantially comprised of thermoplastic materials having a melting point range.

45. A wood-plastic profile according to claim 44, wherein said plastic component comprises between about 97 wt.% and 98 wt.% thermoplastic material.

46. The wood-plastic profile according to Claim 44, wherein said thermoplastic material is substantially polyethylene.

47. The wood-plastic profile according to Claim 35, wherein said plastic component has a melt index of less than about 2.

48. The wood-plastic profile according to Claim 35, wherein said plastic component is comprised of flake-shaped plastic particles.

49. The wood-plastic profile according to Claim 48, wherein each of said flake-shaped plastic particles has a size of less than about 3/4 inches.

50. The wood-plastic profile according to Claim 48, wherein said flake-shaped plastic particles have a bulk density of less than about 3 lbs/ft<sup>3</sup>

51. The wood-plastic profile according to Claim 35, wherein said plastic component is comprised of pellet-shaped plastic particles.

52. The wood-plastic profile according to Claim 51, wherein said pellet-shaped plastic particles have a bulk density of between about 28 lbs/ft<sup>3</sup> and 35 lbs/ft<sup>3</sup>.

53. The wood-plastic profile according to Claim 35, wherein said profile has a thickness of about 1 1/2 inches and a width of between about 3 1/2 to 9 inches.

54. The wood-plastic profile according to Claim 35, wherein said profile has a thickness of about 1 inch and a width of about 5 ½ inches.

55. The wood-plastic profile according to Claim 35 wherein said profile has a thickness of about of 3 1/2 inches and a width of about 3 1/2 inches.

56. The wood-plastic profile according to Claim 35, wherein said profile has a thickness of about 1 ¾ inches and a width of about 1 ¾ inches.

57. The wood-plastic body according to Claim 35, wherein said thermoplastic component is a polyethylene.

58. The wood-plastic body according to Claim 57, wherein said polyethylene has a melt index value greater than the melt index value of the plastic component.

59. The wood-plastic body according to Claim 58, wherein said melt index value is about 5.

60. The wood-plastic body according to Claim 35, wherein said at least one bonding site is an anhydride.

61. The wood-plastic body according to Claim 60, wherein said anhydride is carboxylic acid anhydride.

62. The wood-plastic body according to Claim 61, wherein said carboxylic acid anhydride is a maleic anhydride.

63. The wood-plastic body according to Claim 62 wherein the maleic anhydride content of said bonding agent is greater than about 1 weight percent.

64. The wood-plastic body according to Claim 35, wherein said bonding agent is about 2 wt.%.

65. A wood-plastic composite, having a wood component and a plastic component, wherein said wood component and said plastic component are intermixed to form said wood-plastic composite, said wood-plastic composite having a modulus of rupture of greater than about 1200 psi when tested according to ASTM D476 1, Standard Test Methods for Mechanical Properties of Lumber and Wood-Base Structural Materials.

66. The wood-plastic composite according to Claim 65, wherein said modulus of rupture is greater than about 1800 psi.

67. The wood-plastic composite according to Claim 66, wherein said modulus of rupture is greater than about 2500 psi.

68. The wood-plastic composite according to Claim 65, wherein said modulus of elasticity is greater than about  $4 \times 10^5$  psi.

69. The wood-plastic composite according to Claim 65, wherein said wood-plastic composite is formed as a profile body suitable for use as a rail post.

70. The wood-plastic composite according to Claim 69, wherein said profile body is extruded.

71. An apparatus for making an extruded wood-plastic profile, said apparatus comprising:

- (a) an extruder for providing a heated plastic mass;
- (b) a feeder upstream of said extruder for combining a wood component, a plastic component and a bonding agent into a single feed to form said heated plastic mass; and
- (c) a die assembly attached to said extruder.

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72. The apparatus according to Claim 71, further including a cooling flume downstream from said die assembly.

73. The apparatus according to Claim 72, wherein said cooling flume is an enclosed cooling flume.

74. The apparatus according to Claim 72, wherein said cooling flume has a length greater than about 4 feet.

75. The apparatus according to Claim 74, wherein said cooling flume has a length between about 4 feet and 7 feet.

76. The apparatus according to Claim 72, wherein said cooling flume is adapted to quench said profile with a quenching medium.

77. The apparatus according to Claim 76, wherein said, quenching medium is non-reactive.

78. The apparatus according to Claim 76, wherein said quenching medium is non-oxidizing.

79. The apparatus according to Claim 76, wherein said quenching medium is water.

80. The apparatus according to Claim 71, wherein said plastic component is a thermoplastic material.

81. The apparatus according to Claim 80, wherein said extruder provides said heated plastic mass at a temperature equal to or greater than the melting point of said plastic component.

82. The apparatus according to Claim 81, wherein said extruder provides said heated plastic mass at a temperature equal to or greater than the melting point of low density polyethylene.

83. The apparatus according to Claim 80, wherein said extruder provides said heated plastic mass at a temperature between about 330°F and 350°F.

84. A feeder for an apparatus for making an extruded plastic profile, including a wood component, a plastic component, said wood component and said plastic component being intermixed to form a profile body; and a bonding agent for improving the strength of said wood-plastic profile, said feeder comprising:

- (a) a wood component feeder;
- (b) a plastic component feeder;
- (c) a bonding agent feeder; and
- (d) a feed hopper for combining each of the feeds into one.

85. The feeder according to Claim 84, wherein said feeders are screw feeders.

86. The feeder according to Claim 85, wherein said screw feeders are weigh feeders.

87. The feeder according to Claim 86, wherein said weigh feeders are loss-in-weight feeders.

88. The feeder according to Claim 84, further including a wood component dryer upstream from said wood component feeder for reducing the moisture content of said wood component.

89. The feeder according to Claim 84, further including a pre-heater on at least said plastic component feeder for improving mixing of said plastic component.

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90. The feeder according to Claim 84, wherein said feed hopper further includes a "stuffer."
91. The feeder according to Claim 84, further including an additive feeder.
92. The feeder according to Claim 91, wherein said additive feeder supplies at least one of the chemical modifiers as colorants, mildew inhibitors, insecticides, other fillers, antioxidants, UV-light inhibitors and absorbers, blowing or foaming agents, polymer flow aids, slip, and antiblock.
93. An apparatus for making an extruded wood-plastic profile, said apparatus comprising:
- (a) an extruder for providing a heated plastic mass;
  - (b) a feeder upstream of said extruder for combining a wood component, a plastic component and a bonding agent into a single feed to form said heated plastic mass, said feeder including: (i) a wood component feeder; (ii) a plastic component feeder; (iii) a bonding agent feeder; and (iv) a feed hopper for combining each of the feeds into one;
  - (c) a die assembly attached to said extruder; and
  - (d) a cooling flume downstream from said die assembly.
94. The apparatus according to Claim 93, wherein said cooling flume is an enclosed cooling flume.
95. The apparatus according to Claim 93, wherein said cooling flume has a length greater than about 4 feet.
96. The apparatus according to Claim 95, wherein said cooling flume has a length between about 4 feet and 7 feet.

97. The apparatus according to Claim 93, wherein said cooling flume is adapted to quench said profile with a quenching medium.
98. The apparatus according to Claim 97, wherein said quenching medium is non-reactive.
99. The apparatus according to Claim 97, wherein said quenching medium is non-oxidizing.
100. The apparatus according to Claim 97, wherein said quenching medium is water.
101. The apparatus according to Claim 93, wherein said plastic component is a thermoplastic material.
102. The apparatus according to Claim 101, wherein said extruder provides said heated plastic mass at a temperature equal to or greater than the melting point of said plastic component.
103. The apparatus according to Claim 102, wherein said extruder provides said heated plastic mass at a temperature equal to or greater than the melting point of low density polyethylene.
104. The apparatus according to Claim 101, wherein said extruder provides said heated plastic mass at a temperature between about 330°F and 350°F.
105. The feeder according to Claim 93, wherein said feeders are screw feeders.
106. The feeder according to Claim 105, wherein said screw feeders are weigh feeders.
107. The feeder according to Claim 106, wherein said weigh feeders are loss-in-weight feeders.

108. The feeder according to Claim 93, further including a wood component dryer upstream from said wood component feeder for reducing the moisture content of said wood component.

109. The feeder according to Claim 93, further including a pre-heater on at least said plastic component feeder for improving mixing of said plastic component.

110. The feeder according to Claim 93, wherein said feed hopper further includes a "stuffer."

111. The feeder according to Claim 93, further including an additive feeder.

112. The feeder according to Claim 111, wherein said additive feeder supplies at least one of the chemical modifiers as colorants, mildew inhibitors, insecticides, other fillers, antioxidants, UV-light inhibitors and absorbers, blowing or foaming agents, polymer flow aids, slip, and antiblock.

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